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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 156

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HH-1N IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB. H K HILLE

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Volume 156

HH-1N IN-FLIGHT CREW NOISE

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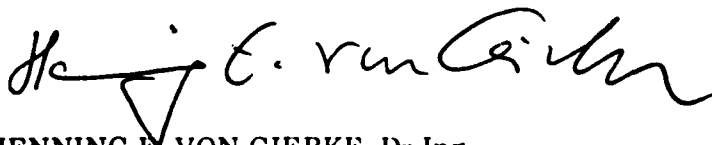
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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



HENNING E. VON GIERKE, Dr Ing
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The HH-1N is a USAF multi-purpose utility helicopter providing support for various USAF missions. This report provides measured data defining the bioacoustic environments at flight crew locations inside this helicopter during normal flight operations. Data are reported for two locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1		

of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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INTRODUCTION

The HH-1N is a multi-purpose helicopter providing support for various Air Force missions. This helicopter, which is manufactured by the Bell Helicopter Textron Company, is powered by the T400-CP-400 Turbo "Twin Pack", consisting of two PT6 turboshaft engines coupled to a combining gearbox with a single turboshaft flat-rated to 1250 shp max power. The engines drive a two-blade rotor with a diameter of 12m and a conventional two-blade tail rotor. The engines are manufactured by the Pratt and Whitney Aircraft Company of Canada.

This volume provides measured data defining the bioacoustic environments produced inside the helicopter. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the HH-1 helicopter.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AFAMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AFAMRL/BBE, Wright Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50(1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured HH-1N helicopter during typical speed, altitude, and flight maneuver conditions. These levels describe the standard HH-1N environments, but may not be representative of those levels encountered if the helicopter has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at two flight crew/passenger locations with the doors and front windows closed and open as indicated in Table 1. This open condition creates airflow of up to 10 knots in velocity inside the helicopter. The wind direction is random and is affected partially by the attitude of the helicopter. A windscreen was used for all data runs to significantly eliminate the turbulence that normally would be generated around the microphone and would otherwise appear in the data as relatively low frequency noise. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone was randomly moved external to the headgear in a region 0.2-0.3 meter from the head and the resultant samples analyzed using a 4- or 8-second integration time to obtain a power-averaged level, which effectively smooths out short duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the HH-1N helicopter at the specified location. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1

MEASUREMENT LOCATIONS AND TEST CONDITIONS
HH-1N, Kirtland AFB NM
Serial No. 233, 25 May 1981

Location	Position	Height Above Deck
1	Between Pilot and Copilot	Seated Head Level
2	Seat, Back Row	Seated Head Level

Condition	Description
A	APU Running - Doors Open
B	Engine Start, APU Running - Doors Open
C	Engine Start, APU Running - Doors Closed
D	Ground Runup - Doors Open
E	Liftoff and Hover 5' Above Ground - Doors Closed
F	Liftoff and Hover 5' Above Ground - Doors Closed
G	Cruise - 500' - 80 KIAS, Front Windows and Doors Open
H	Cruise - 500' - 80 KIAS, Front Windows Open - Doors Closed
I	Cruise - 500' - 60 KIAS, Front Windows Open - Doors Open
J	Descent - Left Door Open
K	Descent - Doors Closed
L	Landing - Left Door Open
M	Liftoff - Left Door Open
N	Hover - 10' Above Ground - Left Door Open
O	Cruise - 500' - 80 KIAS, Doors Open
P	Approach and Descent from 500' - 80 KIAS, Front Windows Open - Doors Closed
Q	Hover 50' - High Torque - Doors Open
R	Hover 50' - High Torque - Doors Closed
S	Hover Above Ground - Rotate 180°
T	Taxi
U	Touch Down - Landing

[illegible]

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											
1/3 OCTAVE BAND											
IDENTIFICATION:											
2	OMEGA 3.2										
TEST BG-082-001											
RUN 02											
03 SEP 82											
PAGE F2											
LOCATION/CONDITION											
FREQ (HZ)	1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S	1/T	1/U	
25	92	91	89	96	102	87	87	85	82	87	87
31.5	94	95	92	98	100	97	93	93	93	83	83
40	89	90	89	95	96	85	84	84	87	82	82
50	87	90	88	93	95	90	88	90	90	83	83
63	84	89	92	89	92	88	87	86	88	84	84
80	81	85	83	88	91	83	83	85	86	78	78
100	85	95	92	91	88	87	86	88	88	79	79
125	82	90	90	88	85	85	82	84	86	72	72
160	85	89	87	86	86	86	79	84	84	76	76
200	84	90	86	85	88	85	80	82	84	77	77
250	85	89	87	88	87	86	80	82	82	79	79
315	83	89	87	91	90	88	84	83	85	80	80
400	82	89	88	89	89	87	81	84	84	79	79
500	84	89	85	84	85	85	82	83	81	81	81
630	84	90	87	86	87	86	83	84	83	78	78
800	81	85	82	85	86	84	78	78	77	74	74
1000	79	85	81	80	80	82	77	76	76	74	74
1250	77	83	79	79	80	80	77	75	75	70	70
1600	75	80	76	76	78	79	77	80	79	73	73
2000	74	79	75	76	76	78	77	76	75	68	68
2500	71	75	72	73	76	74	72	72	68	66	66
3150	71	75	77	73	77	74	73	75	72	68	68
4000	73	78	72	74	76	73	70	75	69	66	66
5000	71	75	71	72	74	73	68	71	68	64	64
6300	71	75	73	72	74	75	69	70	68	64	64
8000	73	77	74	71	74	76	69	70	69	68	68
10000	81	84	77	73	74	79	73	73	72	70	70
OVERALL	99	103	100	103	106	101	98	98	99	93	93
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.											

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											
2											
IDENTIFICATION:											
OMEGA 3.2											
TEST BG-082-001											
RUN 01											
NOISE SOURCE/SUBJECT:											
HH-1N IN-FLIGHT											
CREW NOISE											
OPERATION:											
03 SEP 82											
PAGE J1											
LOCATION/CONDITION											
1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	2/I	1/J	1/K
FREQ (HZ)											
31.5	80	92	90	93	98	104	96	108	107	100	94
63	86	89	87	91	95	96	91	102	98	91	89
125	88	92	90	94	96	95	89	103	94	89	89
250	84	92	90	94	94	94	89	102	91	86	86
500	81	91	91	95	93	92	89	97	92	86	86
1000	81	88	88	92	91	86	82	93	89	80	80
2000	75	80	81	84	85	80	77	86	81	75	77
4000	68	76	76	79	82	75	75	83	80	77	75
8000	71	80	79	83	85	75	71	84	79	75	74
OVERALL	92	99	97	101	103	105	99	111	108	101	97

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											
2 OCTAVE BAND											
IDENTIFICATION:											
OMEGA 3.2											
TEST BG-082-001											
RUN 02											
03 SEP 82											
PAGE J2											
NOISE SOURCE/SUBJECT:											
HH-IN IN-FLIGHT											
CREW NOISE											
OPERATION:											
LOCATION/CONDITION											
1/L 1/M 1/N 1/O 1/P 1/Q 1/R 1/S 1/T 1/U											
FREQ (HZ)											
31.5											
63											
125											
250											
500											
1000											
2000											
4000											
8000											
OVERALL											

TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:
3													
NOISE SOURCE/SUBJECT: (OPERATION:)													OMEGA 3.2
HH-1N IN-FLIGHT	(TEST BG-082-001
CREW NOISE	(RUN 01
	(03 SEP 82
	(PAGE H1
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)													
NO PROTECTION													
OASLC	92	98	97	101	102	97	103	97	109	105	99	96	
OASLA	85	92	92	96	95	89	93	89	99	93	87	87	
T	404	120	120	60	71	202	101	202	36	101	285	285	
HGU-2A/P HELMET WITH CUSTOM LINER													
OASLA*	81	89	88	93	91	86	90	86	96	90	84	83	
T	807	202	240	101	143	339	170	339	60	170	480	571	
U-51R EAR PLUGS													
OASLA*	62	69	69	73	72	67	71	67	77	71	65	64	
T	960	960	960	960	960	960	960	960	960	960	960	960	
H-157 IN-FLIGHT COMMUNICATION UNIT													
OASLA*	70	76	75	79	79	75	79	73	86	78	72	71	
T	960	960	960	960	960	960	960	960	339	960	960	960	
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL	79	86	86	90	89	83	86	82	92	87	81	81	
ANNNOYANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)													
TONE CORRECTION (C IN DB)													
PNLT	100	105	105	109	108	104	107	104	113	107	104	103	
C	3	1	1	1	0	1	1	2	0	1	2	2	

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE												
3												
IDENTIFICATION:												
OMEGA 3.2												
TEST BG-082-001												
RUN 02												
03 SEP 82												
PAGE H2												
NOISE SOURCE/SUBJECT: OPERATION:												
HM-IN IN-FLIGHT												
CREW NOISE												
LOCATION/CONDITION												
1/L 1/M 1/N 1/O 1/P 1/Q 1/R 1/S 1/T 1/U												
HAZARD/PROTECTION												
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR												
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR												
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)												
NO PROTECTION												
OASLC	98	102	99	102	104	99	96	97	98	92		
OASLA	90	95	91	92	93	92	89	90	89	84		
T	170	71	143	120	101	120	202	170	202	480		
HGU-2A/P HELMET WITH CUSTOM LINER												
OASLA*	86	92	88	89	90	89	84	85	85	81		
T	339	120	240	202	170	202	480	404	404	807		
U-51R EAR PLUGS												
OASLA*	67	72	69	70	71	69	65	66	66	62		
T	960	960	960	960	960	960	960	960	960	960		
H-157 IN-FLIGHT COMMUNICATION UNIT												
OASLA*	73	79	77	78	78	76	72	73	74	68		
T	960	960	960	960	960	960	960	960	960	960		
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	83	89	85	86	87	87	83	84	83	79		
ANNOYANCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)												
TONE CORRECTION (C IN DB)												
PNLT	104	109	107	106	107	106	103	105	104	99		
C	1	1	2	1	0	1	1	2	1	1		
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.												